



# User's Manual

(Linear Series)Rev.1.0



Reference No.  
AR08RD001C-EN

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## User's manual (machine)

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#### 2. Operation of Alpha Linear Motor

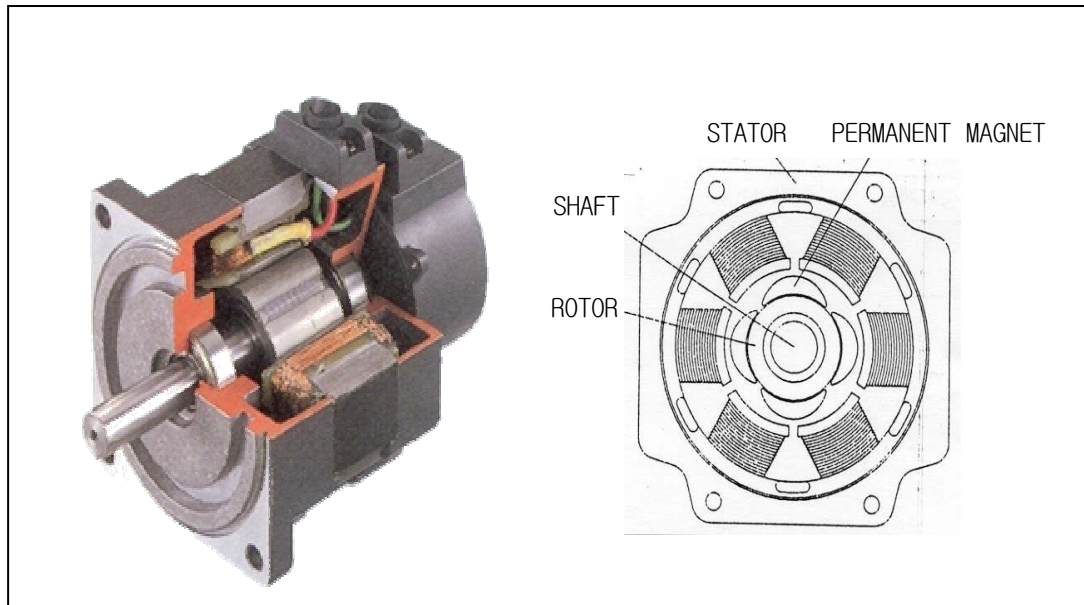
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## 1. Explanation of Linear Motor

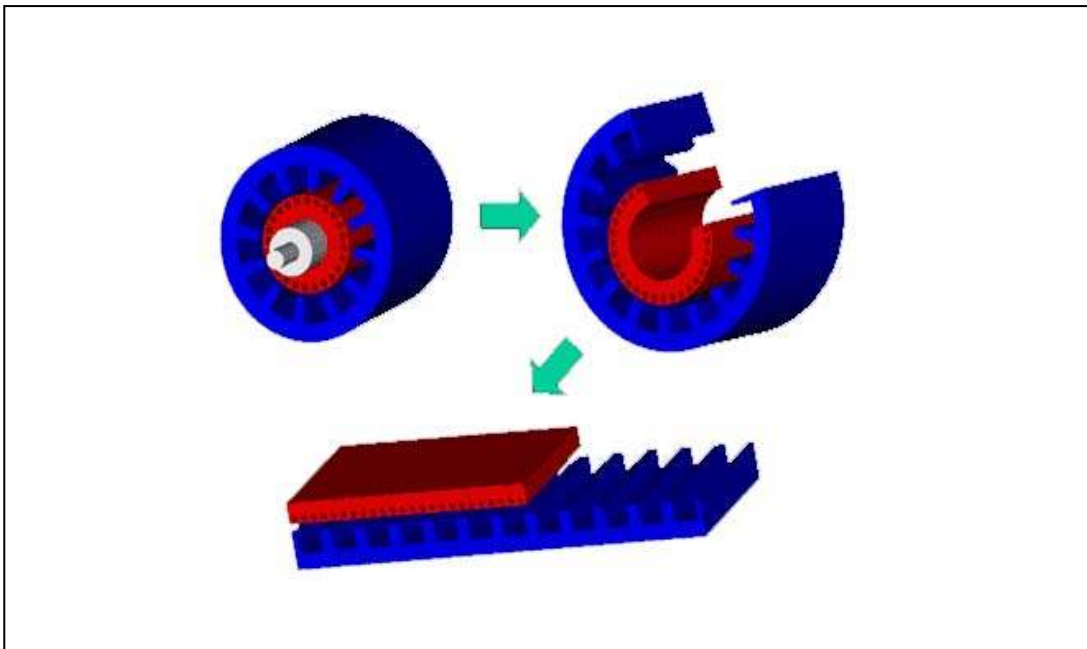
### 1.1 Driving principle of Linear Motor

Comparison of internal structure between general Servo Motor and Linear Motor

#### 1.1.1 Internal structure of general Servo Motor

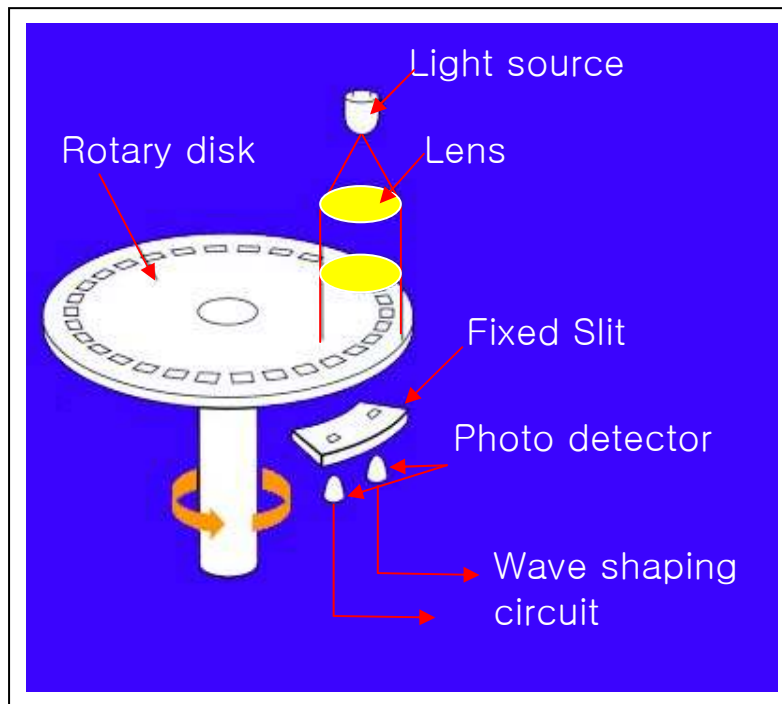


#### 1.1.2 Internal structure of Linear Servo Motor

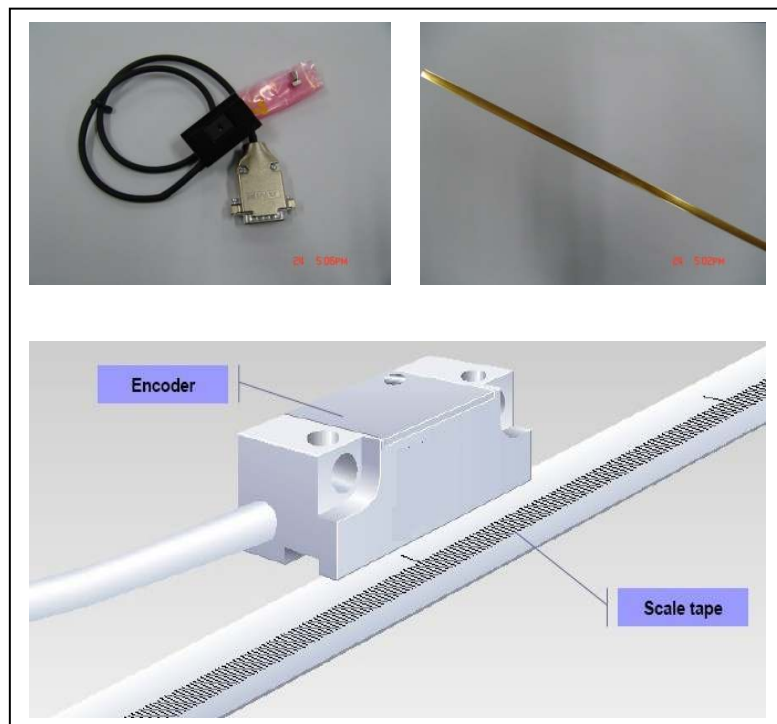


### 1.1.3 Comparison of Encoder structure between Servo Motor and Linear Motor

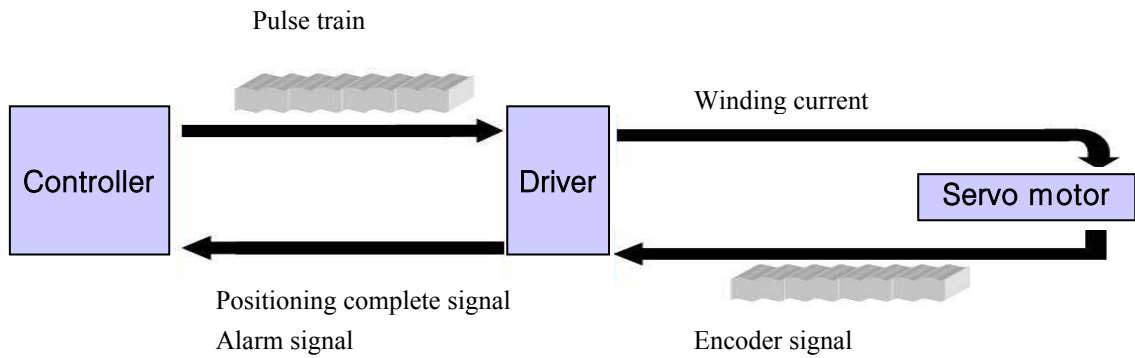
#### a. Internal structure of Servo Motor



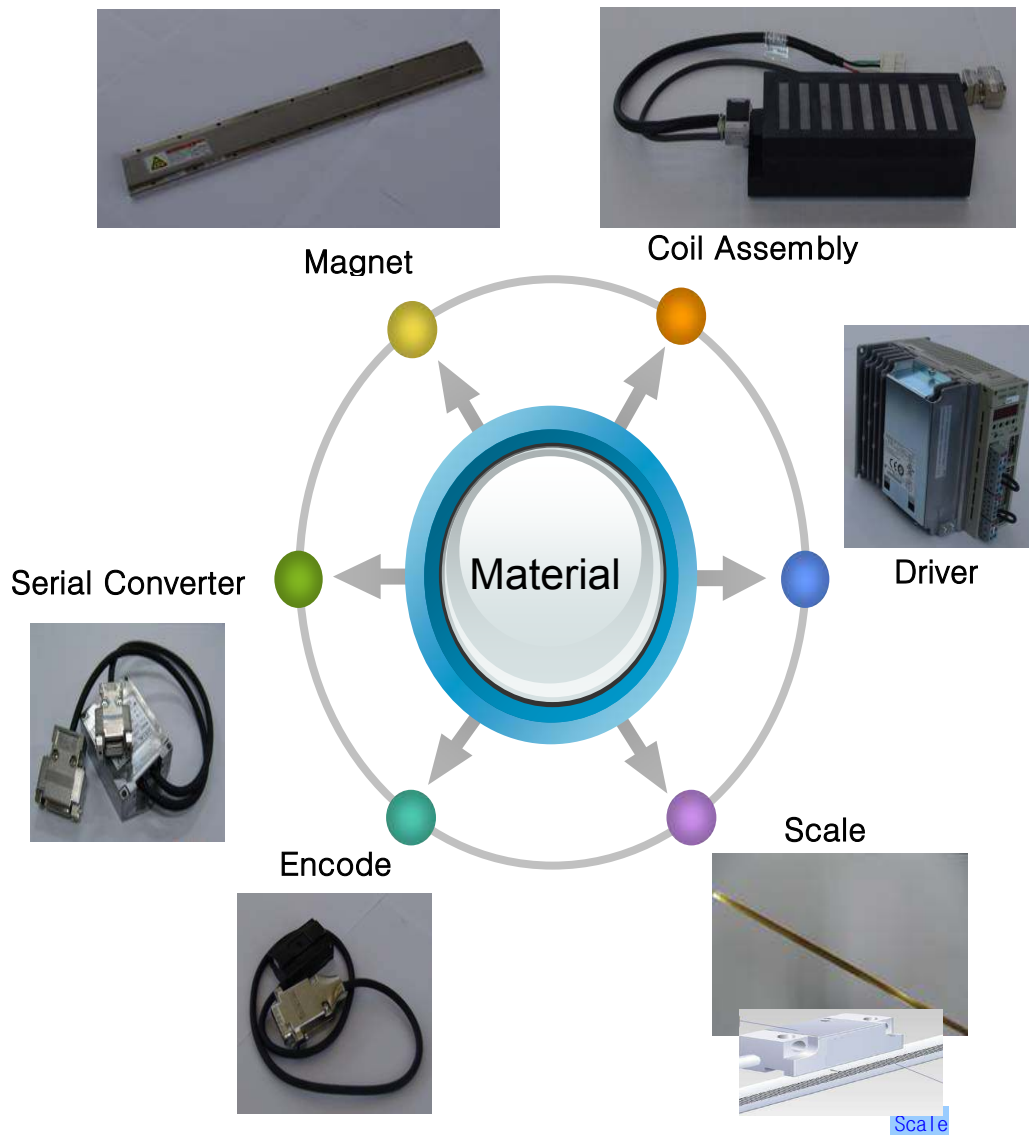
#### b. Internal structure of Linear Servo Motor



#### 1.1.4 Comparison of Encoder structure between Servo Motor and Linear Motor



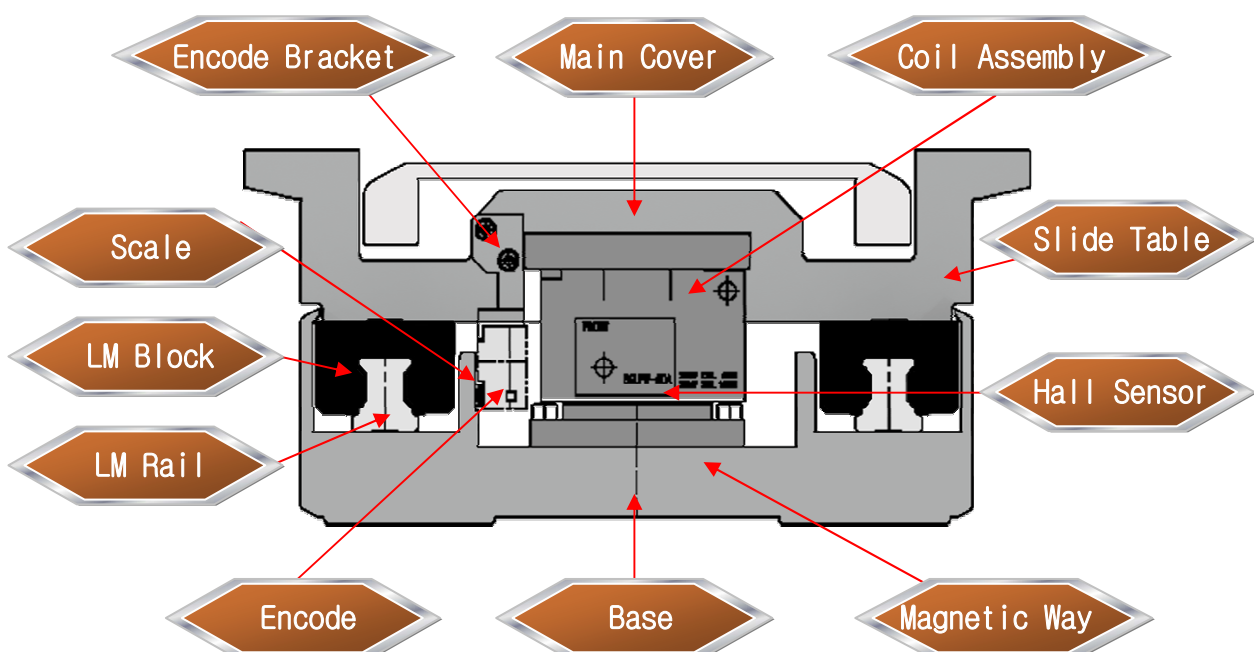
#### 1.2 Composition of Linear Motor



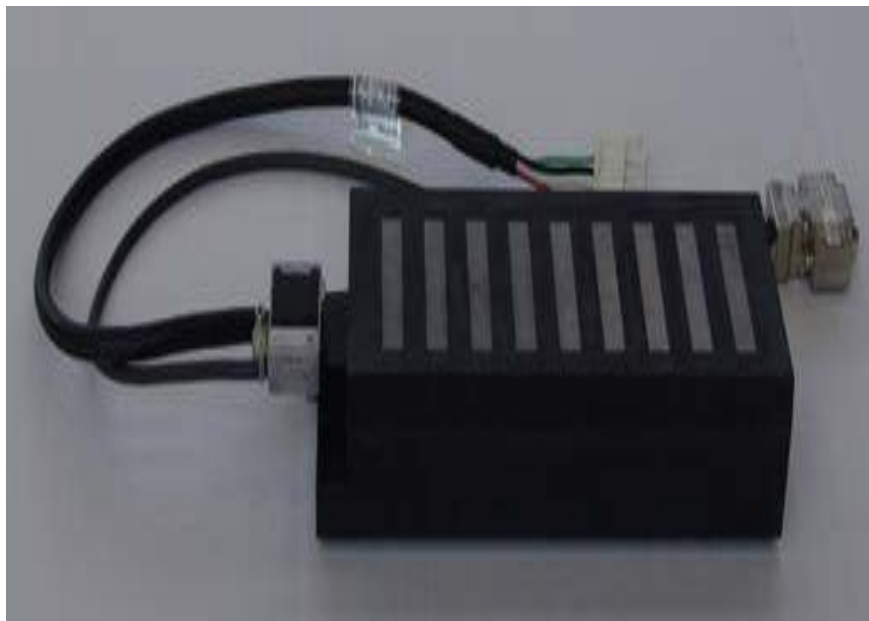
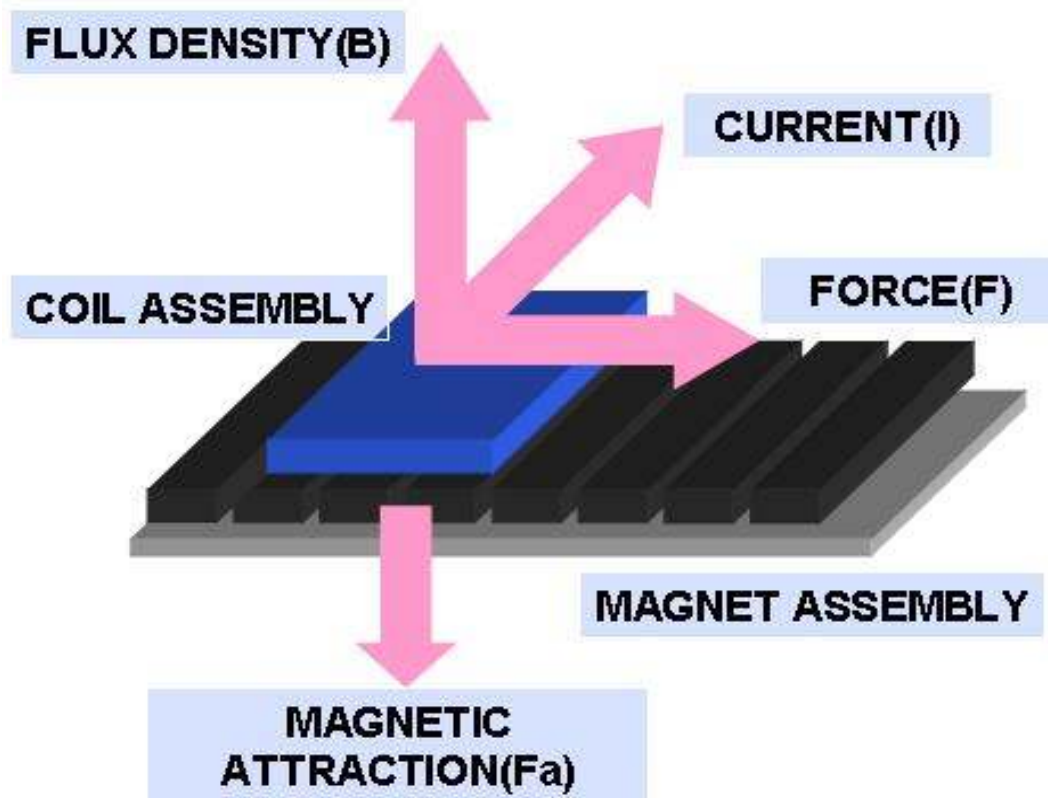
### 1.3 Features of Linear Motor

High precision & repeatability	By using of linear scale as Encoder system for positioning feedback, there is almost no mechanism error.
Simplicity / High torque	As mechanism consists of coil as mover and permanent magnet as stator, high torque occurs without mechanical interference.
High speed / high acceleration	High speedy and accelerated operations are possible due to no contact movement between mover and stator.
High efficiency	As no contact movement, there is no wear and tear of motor which causes inefficiency of motor.
Semi-permanency	There is no mechanical processing tolerance due to sufficient allowable tolerance between mover and stator.
No vibration	It is suitable for LCD and/or semi-conduct manufacturing process owing to no vibration.

### 1.4 Sectional drawing of Alpha Linear motor



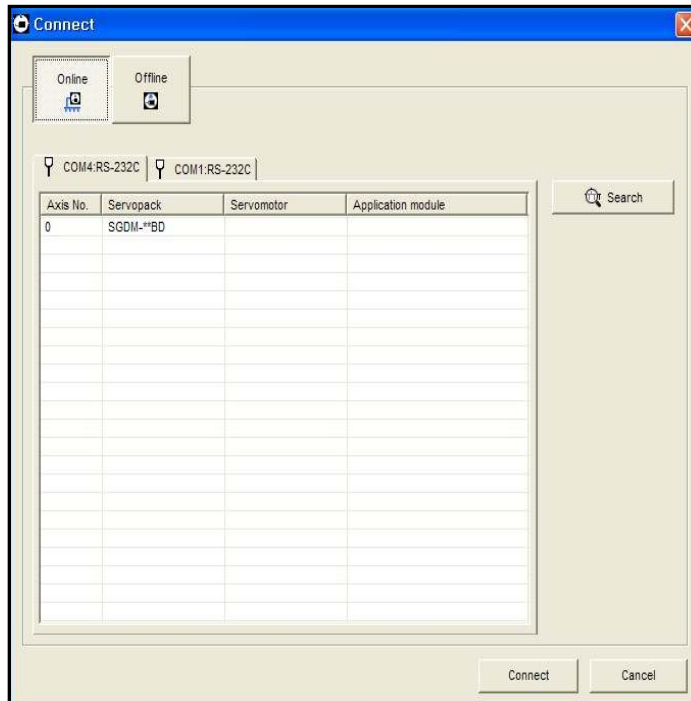
### 1.5 Operating direction of Alpha Linear motor



## 2. Operation of Alpha Linear motor

### 2.1 Connection process of Sigma Win Plus Program

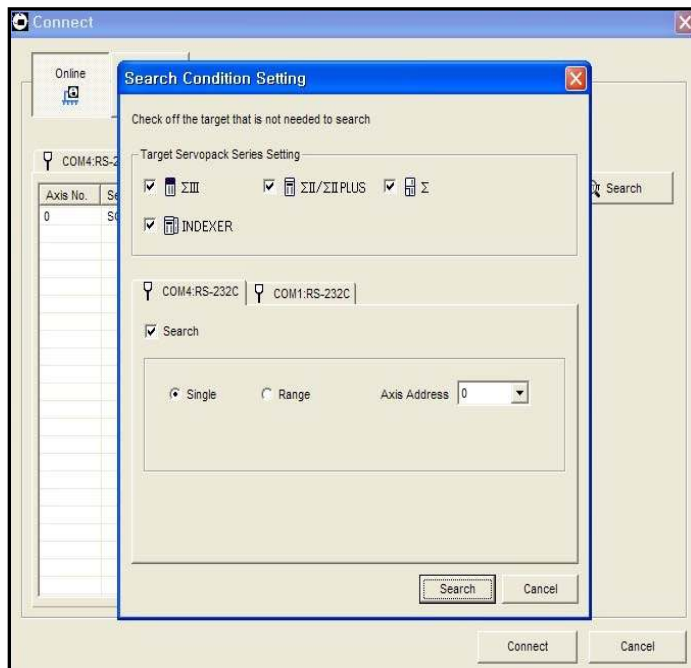
#### 2.1.1 Screen of starting program



a. When starting program, left screen occurs.

b. Start searching for Linear motor by click of search located in right top corner.

#### 2.1.2 Selecting and checking searched model

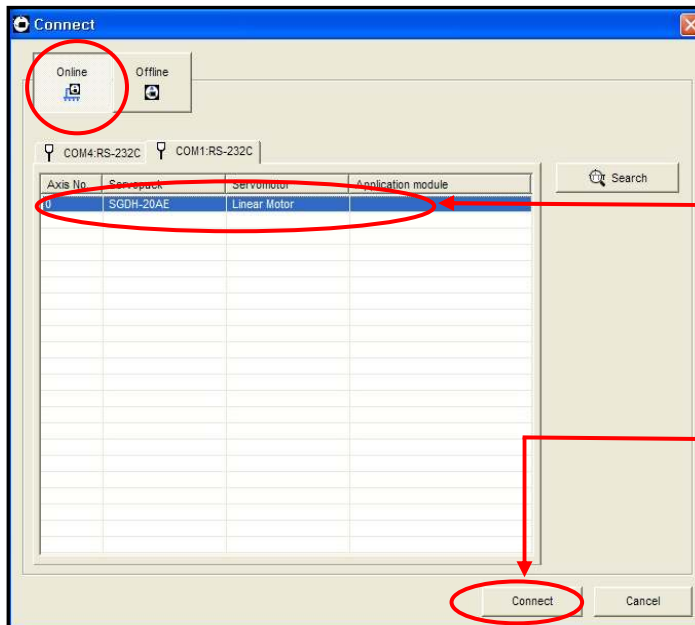


a. When clicking the Search on the previous screen, left screen occurs.

b. Click all check boxes, and then click search on the bottom.



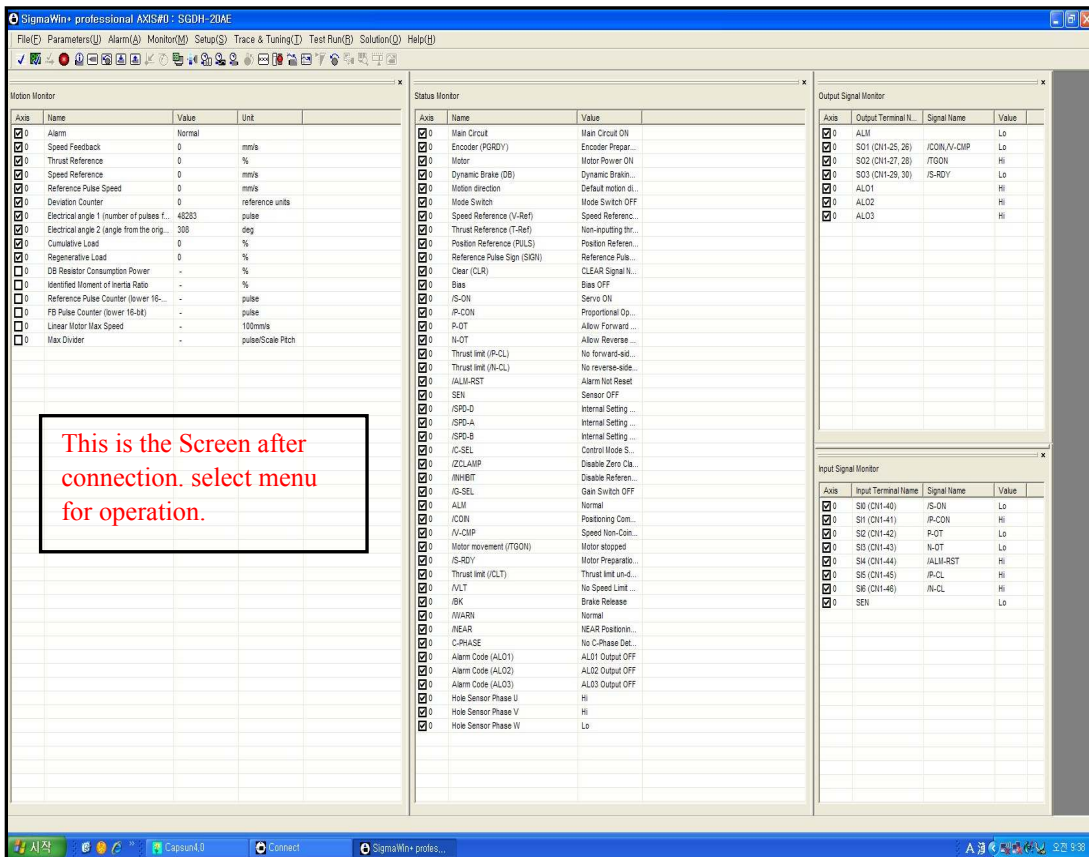
### 2.1.3 Connecting searched model



a. Left screen occurs after success working of the previous screen.

b. Click the searched Linear Driver so as to turn the line blue color and then click the connect button on the bottom.

### 2.1.4 Successful Screen after connection

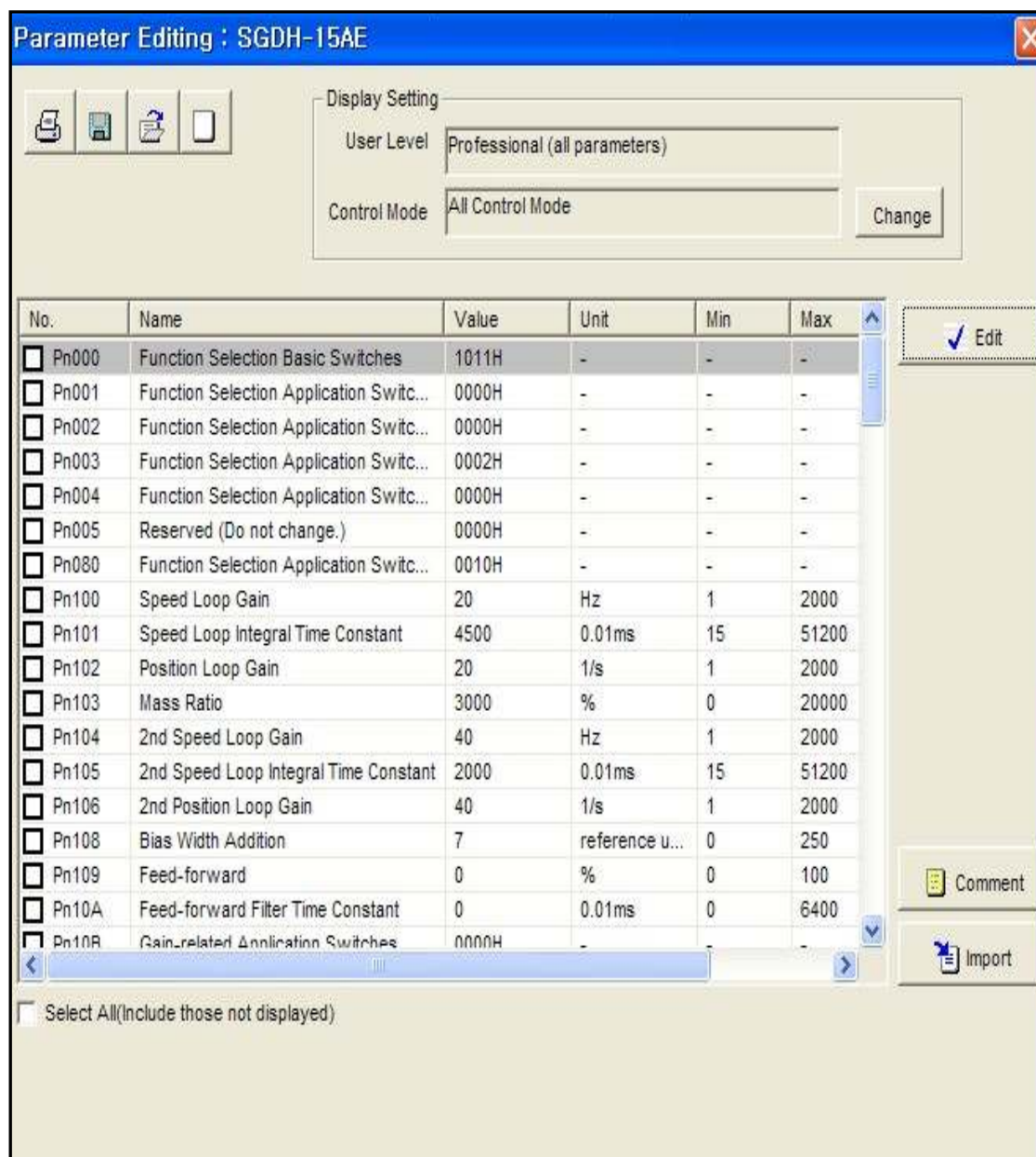


## 2.2 Setting / Tuning for Alpha Linear motor

### 2.2.1 Selecting menu for Setting / Tuning of Linear motor



- Click Parameters(U) → Edit Parameter .
- Or click red circle(Icon menu).



- On the above screen, click and amend Pn(Parameter) as requested.

### 2.2.2 Setting of Alpha-Linear motor

The screenshot shows a software window titled "Edit" with a close button in the top right corner. Inside the window, there is a label "Pn000" followed by a text field containing "Function Selection Basic Switches". Below this, there are four sections, each with a label and a dropdown menu:

- nibble 0 Direction Selection**: The dropdown menu shows "1 : Reverse direction."
- nibble 1 Control Method Selection**: The dropdown menu shows "1 : Position control (pulse train reference)".
- nibble 2 Axis Address**: The dropdown menu shows "0 : Sets Servopack axis address."
- nibble 3 Rotary/Linear Selection (encoder not connected)**: The dropdown menu shows "1 : Starts in linear mode."

At the bottom left, there is a text field containing "1011" followed by the letter "H". At the bottom right, there are two buttons: "OK" and "Cancel".

a. The above is Edit screen for amendment after clicking each Pn. set up with value as requested.

b. Refer explanation for each set point of Nibble.

### 2.2.3 Setting of Alpha-Linear motor

- a. Pn000 : 0000H → 1010H Explanation : Use of Linear motor and position Control Mode, Operation of forward direction selected.
- b. Pn080 : 0000H or 0010H Explanation : A phase / B phase of motor  
Standard operation – Switch according to status of Linear motor
- c. Pn110 : 0010H is auto-tuning mode and 0012H is manual-tuning mode.  
Recommend manual -tuning mode.  
When using auto-tuning mode, convert manual-tuning mode after using of 1~5 times of auto-tuning mode.
- d. Pn202 / Pn203 : As Parameter of adjusting electric gear ratio, set up linear motor through following method.  
Explanation : Pn202 is a position value(unit :  $\mu\text{m}$ ) X 256(appointed value of servo) when inputting one pulse. Pn203 is pitch value of linear scale(unit :  $\mu\text{m}$ )  
Input - Alpha use scale of  $40\mu\text{m}$ ,  $20\mu\text{m}$  generally.  
Input a value reduced by Pn 202 as numerator and Pn203 as denominator.
- e. Pn280 : Setting up pitch value of linear scale.  
Alpha use scale of  $40\mu\text{m}$ ,  $20\mu\text{m}$  generally
- f. Pn483 ,Pn484 : Limited thrust value of forward and reverse direction.  
When shipping from factory, the value is 30%, but set up about 300% when using.

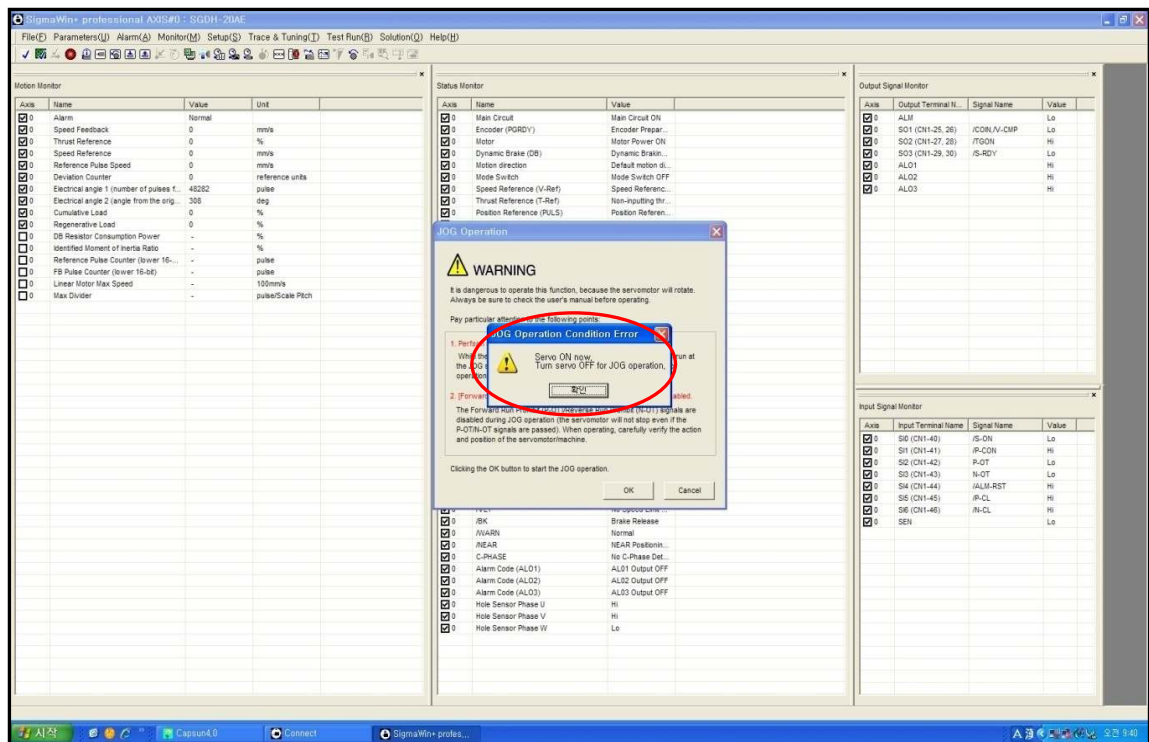
## 2.3 Manual operation of Linear motor

### 2.3.1 Selecting menu for manual operation of linear motor



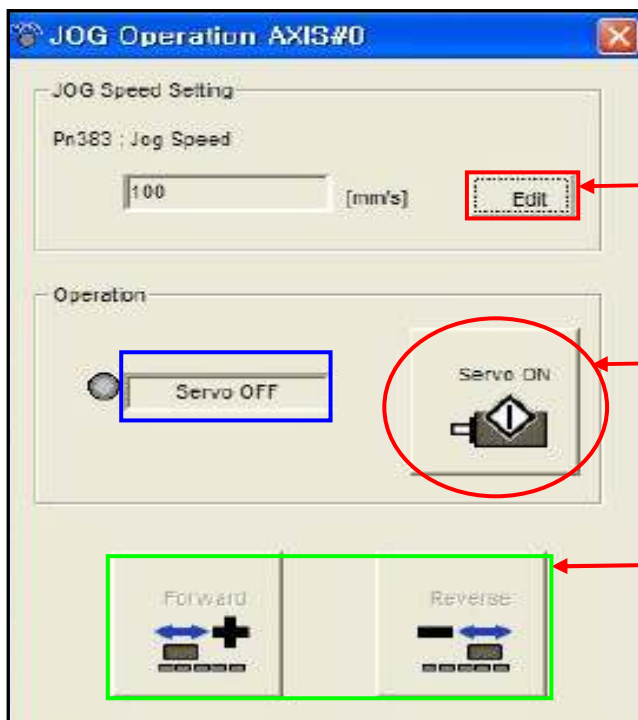
- a. Click Test Run on menu.
- b. After clicking Test Run, small menu, JOG, occurs
- c. Click JOG menu and then window of warning message for careful using occurs.  
Click OK on the window of warning message, then Dialog box for manual operation occurs.  
When servo is turn on, message of being unable to use manual operation occurs  
Following page indicates screens of warning

### 2.3.2 Warning and error message when Servo is turned on



### 2.3.3 Dialog box for manual operation

- a. After completion of Test Run→ JOG, Dialog box showed below occurs and manual operation is available.



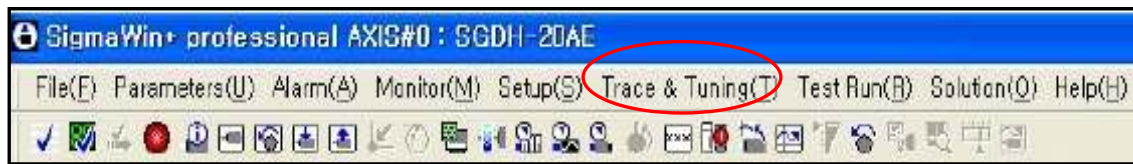
b. Click the Edit and adjust speed of manual operation.

c. Click the Servo on, then the blue mark swift to servo on, then test run is available.

d. Two buttons of left box are operable. Using the two buttons, forward and reverse operation are available.

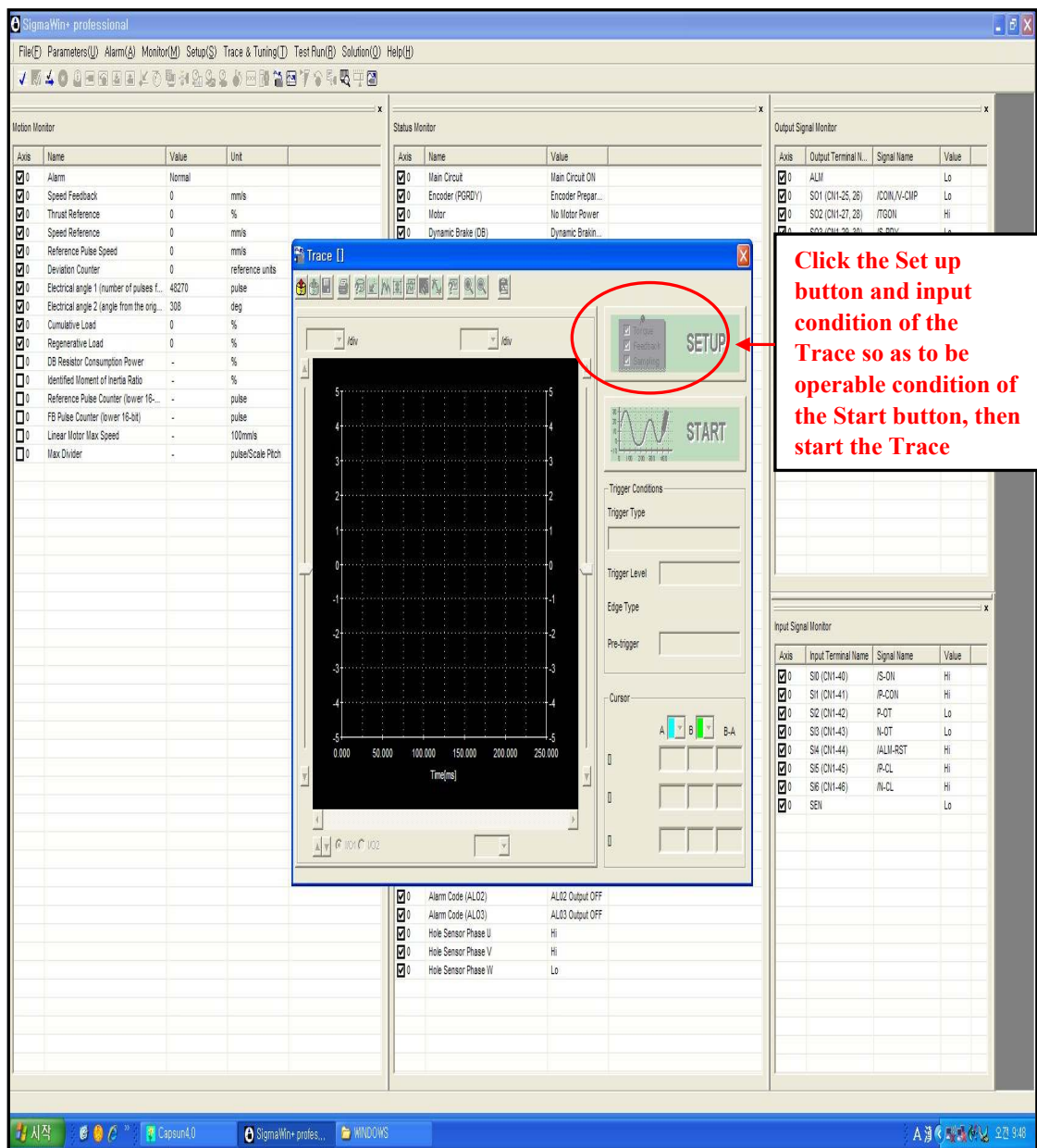


## 2.4 Early inspection of Linear motor

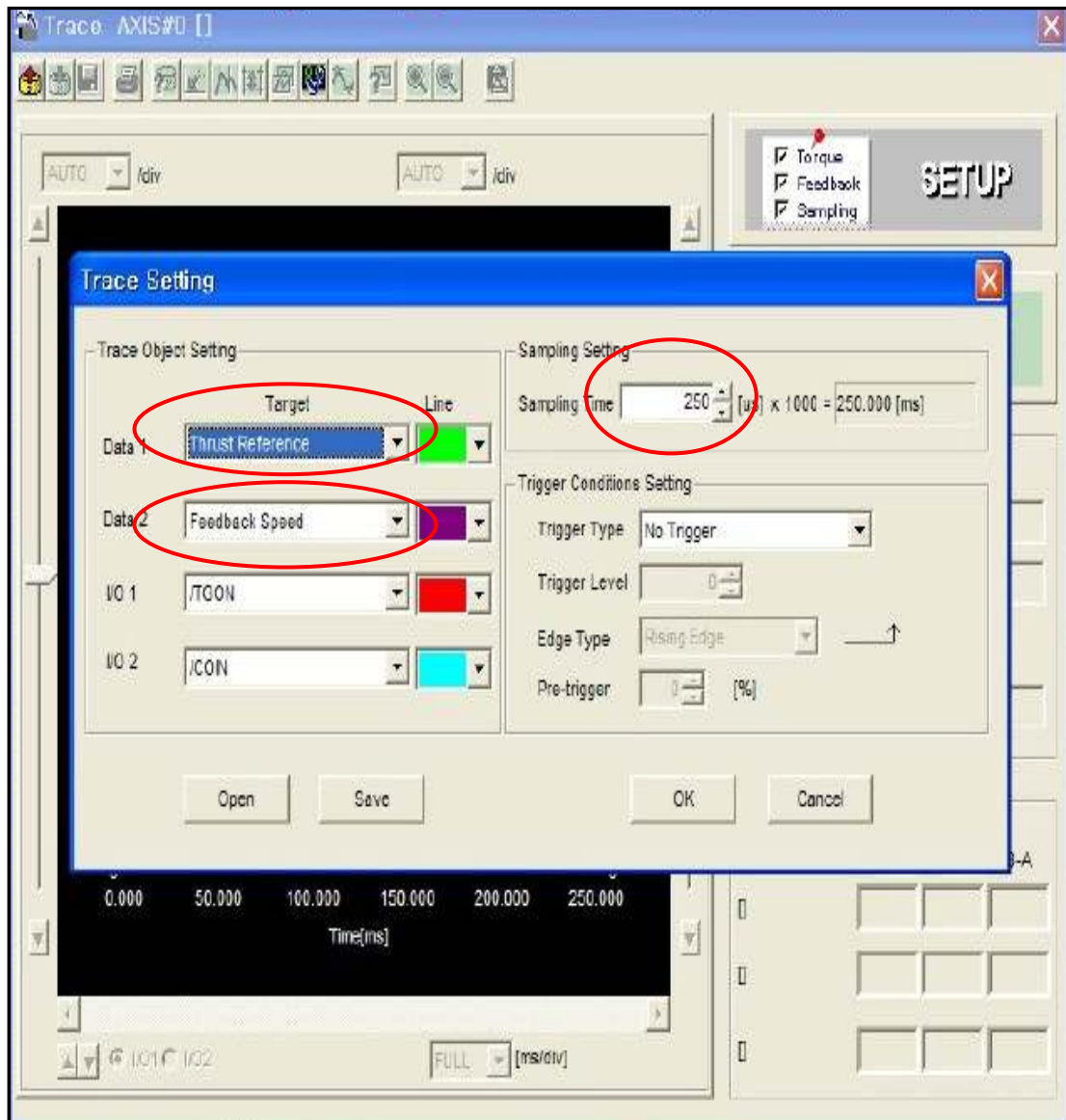


- Early inspection is explained through the Trace function provided by Yaskawa
- Click the Trace & Tuning on the menu shown above, then Pop up menu occurs,  
then click the Trace on Pop up menu, then following screen

### 2.4.1 Trace Menu의 선택화면



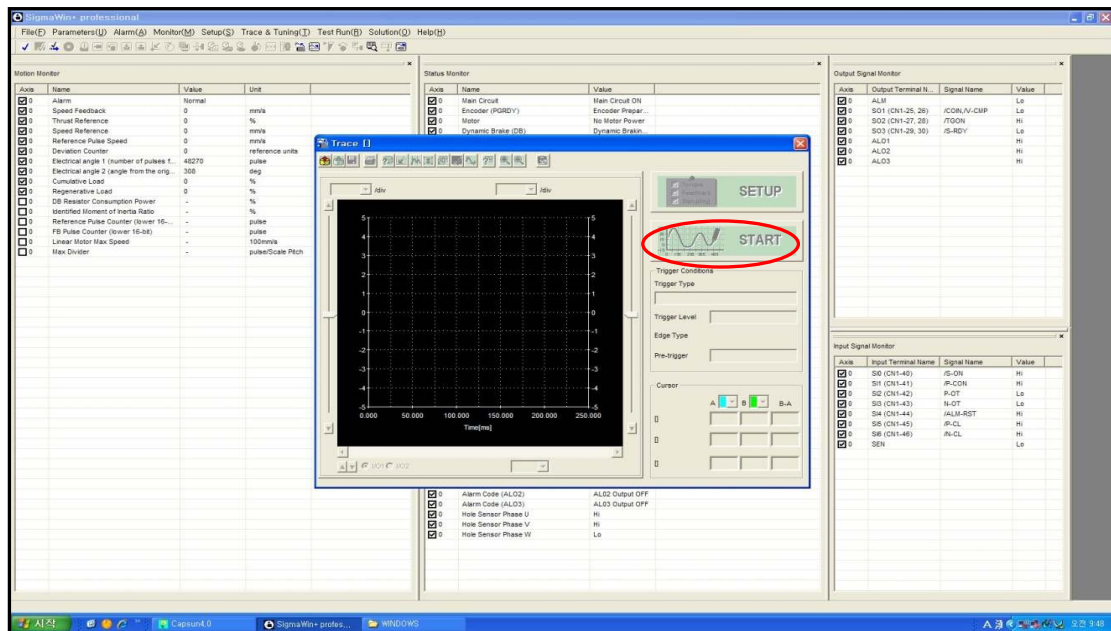
## 2.4.2 Setting up the Trace Setting



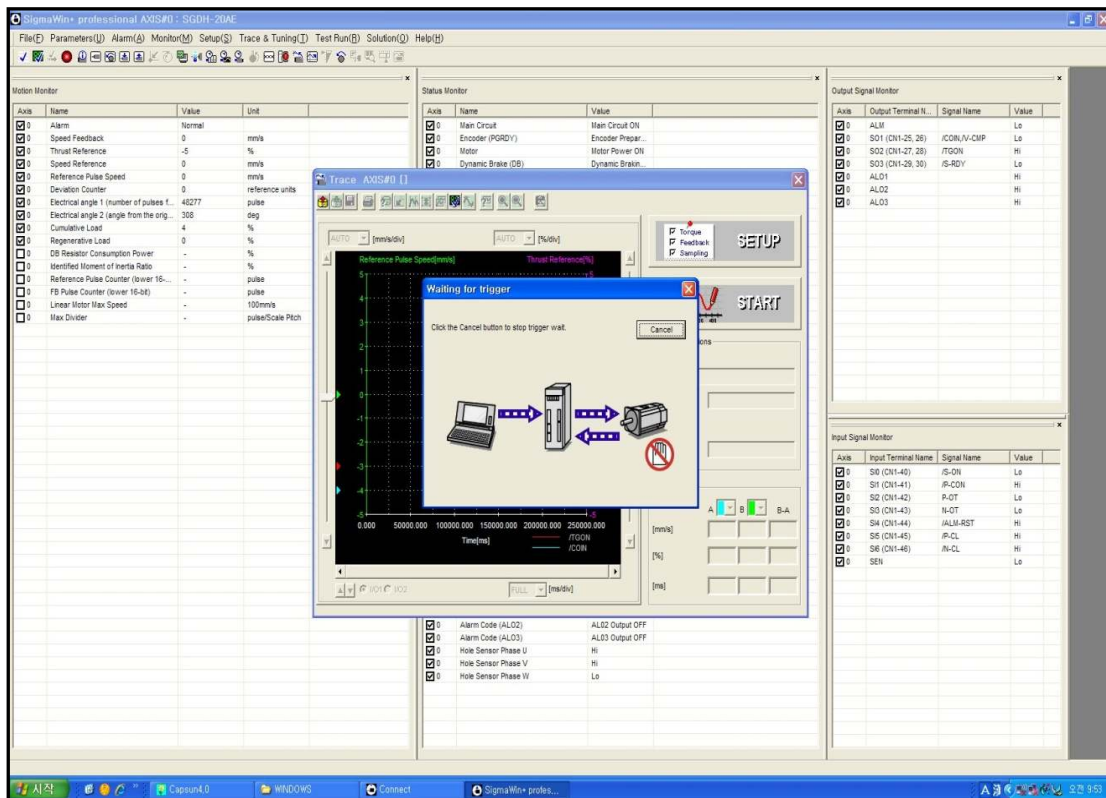
- Two kinds of Data corresponding to user's purpose are selective and printed out with Graph.
- Generally, there are two data, Thrust reference and Feedback speed, for early inspection.  
Early inspection process is that select the two above data and check the change of the Thrust reference in proportion to the Feedback speed.
- Setting up Trace time is available with inputting time in the red circled box.
- Unit is ms 's unit.

### 2.4.3 Starting Trace

- After completion of the Set up, the Start button circled with red color become operable.  
Click the Start, then the Trace starts as assigned time.

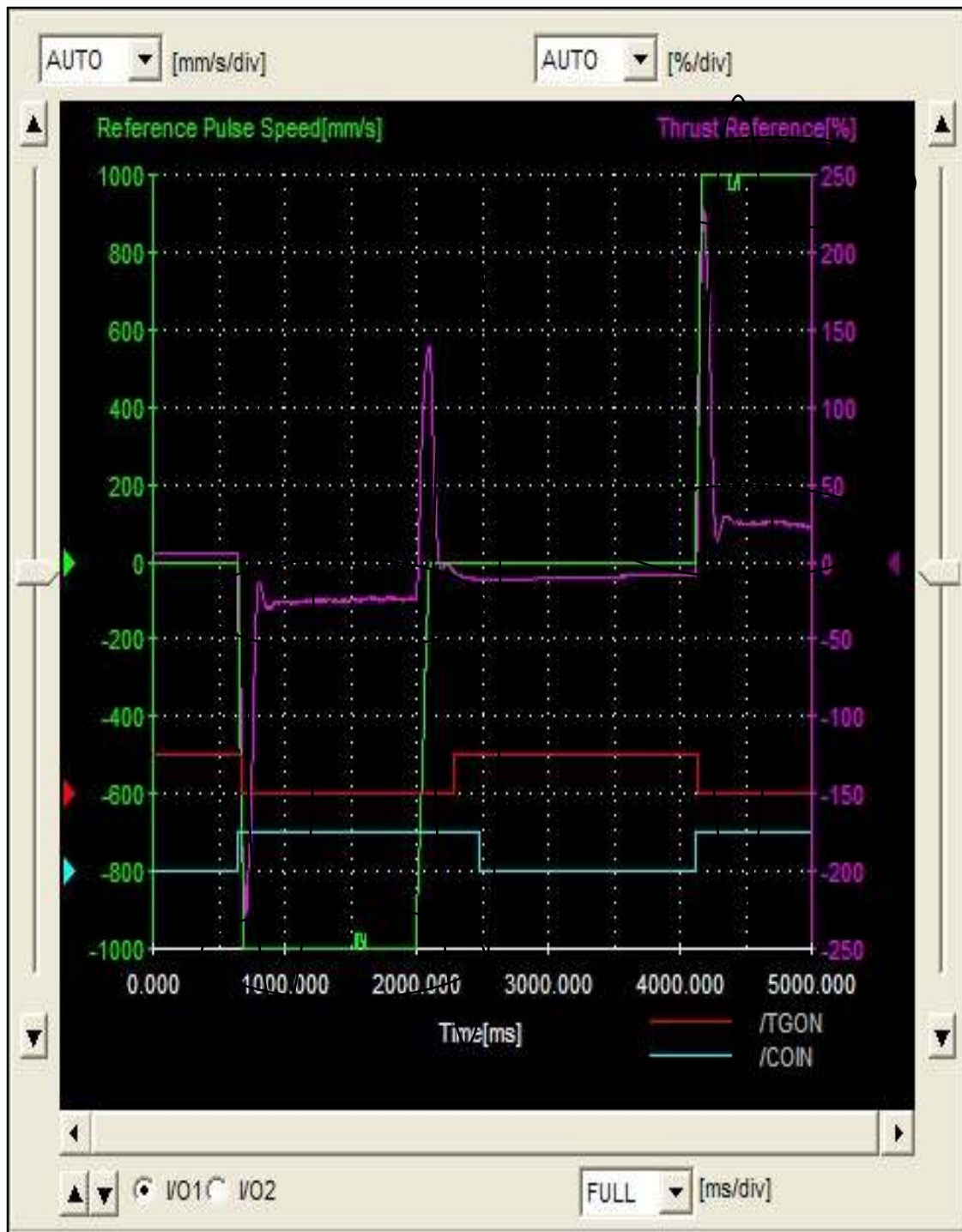


- Follow screen shows successful start of the Trace.
- Incorrect conditions or edits are revocable by the Cancel button.





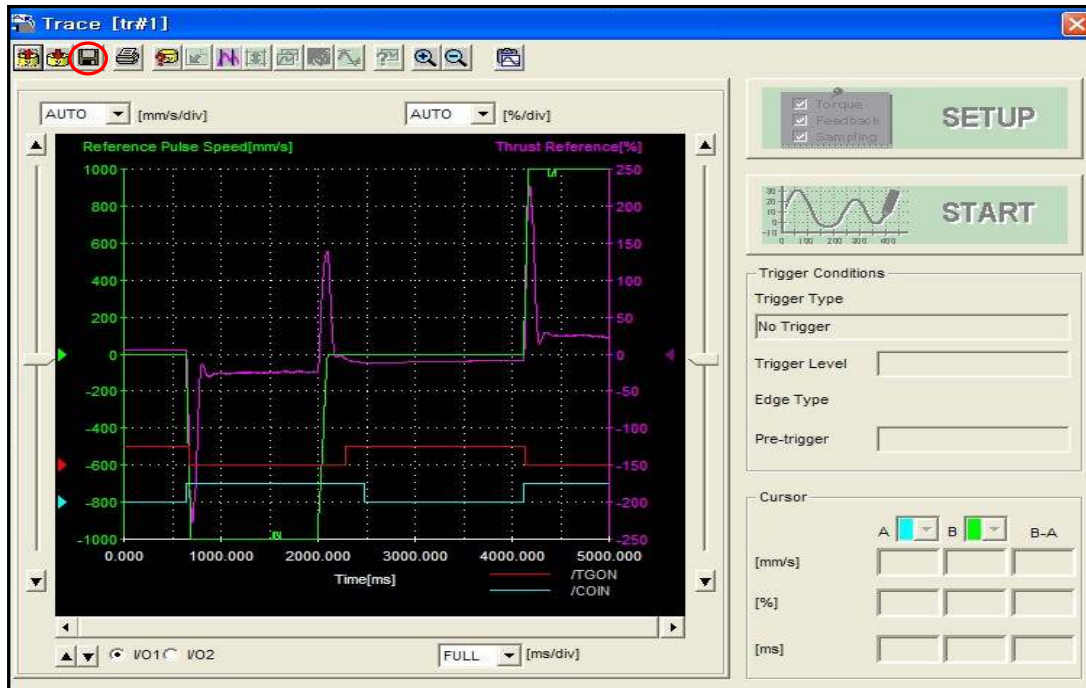
#### 2.4.4 Interpretation of Graph



- Red line indicates that the Thrust reference(purple line) increases in the section of acceleration and deceleration(green line).
- The Thrust reference is uniform in the section of uniform velocity.
- If there are great changes of the Thrust reference in the certain section, problems or mechanical inference may be assumed and so urgent treatment is required.

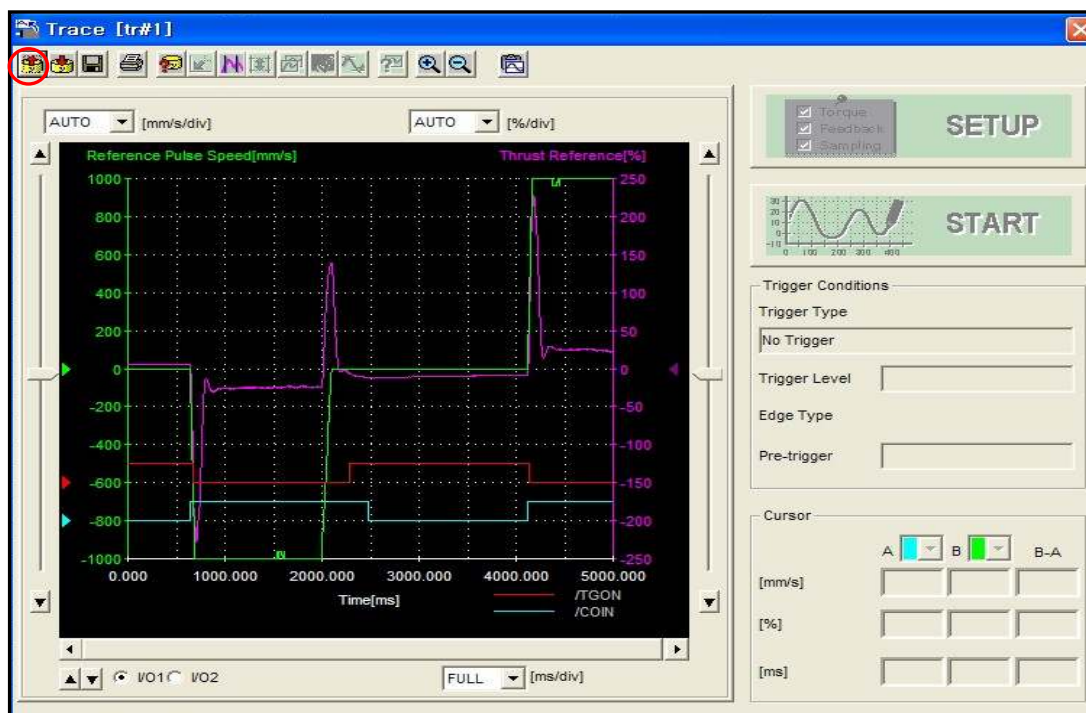
## 2.4.5 Saving Graph

- Measured graph may be saved by clicking the red circled save icon.



## 2.4.6 Opening Graph

- Saved graph will be opened by clicking red circled open icon.



## 2.5 Troubleshooting of Alarm and Warning of Linear motor (based on Sigma 3 (SGDS))

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.040	Parameter setting error (The parameter setting was out of the allowable setting range)	Occurred when the control power supply was turned ON.	The Servopack and Servomotor capacities do not match each other.	Select the proper combination of Servopack and servomotor capacities.
			The Servopack EEPROM and the related circuit are faulty.	Replace the Servopack.
A.041	Dividing pulse output setting error	Occurred when the control power supply was turned ON.	The PC dividing pulse set for Pn281 is out of the setting range and does not satisfy the setting conditions.	Set Pn 281 to the correct value.
A.080	Linear scale pitch setting error	Occurred when the control power supply was turned ON.	The setting value of Pn282 (Linear scale pitch setting) is the factory setting.	Correct the setting value of Pn282.
A.840	Encoder data error (Detected on the serial converter unit side)	Occurred when the control power supply was turned ON.	A malfunction occurred in the serial converter unit.	Turn the control power supply OFF and then ON again. If this alarm occurs frequently, replace the serial converter unit.
			A servopack board fault occurred.	Replace the servopack.
		Occurred during operation	A malfunction occurred in the serial converter unit.	Correct the wiring around the serial converter unit by separating the serial converter unit cable from the power line, or by checking the grounding and other wiring.
			A serial converter unit fault occurred.	If this alarm occurs frequently, replace the serial converter unit.
			A servopack board fault occurred.	Replace the servopack.

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.710 A.720	Overload : A.710 : Instantaneous peak load  Overload : A.720 : Continuous peak load	Occurred when the control power supply was turned ON.	A servopack board fault occurred.	Replace the servopack.
		Occurred when the servo was turned ON.	The servomotor wiring is incorrect or the connection is faulty.	Correct the servomotor wiring.
			The encoder wiring is incorrect or the connection is faulty.	Correct the encoder wiring.
			A servopack fault occurred.	Replace the servopack.
		Occurred when the servomotor did not run by the reference input.	The servomotor wiring is incorrect or the connection is faulty.	Correct the servomotor wiring.
			The encoder wiring is incorrect or the connection is faulty.	Correct the encoder wiring.
			The starting force exceeds the maximum force.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			The polarity detection is not performed properly. (When Pn080.0=1 is set)	Correct the settings for the polarity detection related parameter.
			A servopack fault occurred.	Replace the servopack.
		Occurred during normal operation.	The actual force exceeds the rated force or the starting force largely exceeds the rated force.	Reconsider the load and operation conditions, or reconsider the servomotor capacity.
			A servopack fault occurred.	Replace the servopack.

Alarm Display	Alarm Name	Situation at Alarm occurrence	Cause	Corrective Actions
A.300	Regeneration error detected (Detected when the power to the main circuit was turned ON.)	Occurred when the control power supply was turned ON.	A servopack board fault occurred.	Replace the servopack.
		Occurred when the main circuit power supply turned ON.	Pn 600 is set to value other than "0" for a servomotor of 400W or less, and an external regenerative resistor is not connected.	Connect an external regenerative resistor, or set Pn600 to "0" if an external regenerative resistor is not connected.
			Check for incorrect wiring or a disconnected wire in regenerative resistor.	Correct the wiring for the external regenerative resistor.
			A servopack fault occurred, such as regenerative transistor or a voltage sensor fault.	Replace the servopack.
		Occurred during normal operation.	Check for incorrect wiring and disconnection of the regenerative resistor.	Correct the wiring for the external regenerative resistor.
			The jumper between B2 and B3 is removed for a servomotor of 500W or more.	Correct the wiring.
			The regenerative resistor is disconnected, so the regenerative energy became excessive.	Replace the regenerative resistor or replace the servopack. Reconsider the load and operation conditions.
			A servopack fault, such as regenerative transistor and voltage sensor fault, occurred.	Replace the servopack.

Alarm Display	Alarm Name	Situation at Alarm Occurrence	Cause	Corrective Actions
A.320	Regenerative Overload (Detected when the power to the main circuit is turned ON.)	Occurred when the control power supply was turned ON.	A servopack board fault occurred.	Replace the servopack.
		Occurred when the main circuit power supply was turned ON.	The power supply voltage is 270V or more.	Correct the input voltage.
		Occurred during normal operation (large increase of regenerative resistor temperature)	The regenerative energy is excessive.	Select a proper regenerative resistance capacity, or reconsider the load and operation conditions.
			The regenerating state continued.	
		Occurred during normal operation (small increase of regenerative resistor temperature)	The setting of parameter Pn 600 is smaller than the external regenerative resistor's capacity.	Correct the set value of parameter Pn600.
			A servopack fault occurred.	Replace the servopack.
		Occurred at servomotor deceleration.	The regenerative energy is excessive.	Select a proper regenerative resistance capacity, or reconsider the load and operation conditions.

Alarm Display	Alarm Name	Situation at Alarm occurrence	Cause	Corrective Actions
A.400	Overvoltage (Detected when the servopack's main circuit DC voltage is 410V or more) (Detected when the power to the main circuit is turned ON.	Occurred when the control power supply turned ON.	A servopack board fault occurred.	Replace the servopack.
		Occurred when the main circuit power supply was turned ON.	The AC power voltage is 290V or more.	The AC power voltage must be within the specified range.
			A servopack fault occurred.	Replace the servopack..
		Occurred during normal operation.	Check the AC power voltage (check if there is no excessive voltage change.)	The AC power voltage must be within the specified range.
			The motor speed is high and load mass is excessive, resulting in insufficient regenerative capacity.	Check the load mass and minus load specification. Reconsider the load and operation conditions.
			A servopack fault occurred.	Replace the servopack.
		Occurred at servomotor deceleration.	The motor speed is high, and the load mass is excessive.	Reconsider the load and operation conditions.

Alarm Display	Alarm Name	Situation at Alarm occurrence	Cause	Corrective Actions
A.820	Encoder checksum error (Detected on the serial converter unit side)	Occurred when the control power supply was turned ON.	A fault occurred in the serial converter unit and was detected by serial converter unit self-diagnosis.	Set up the serial converter unit. If this alarm occurs frequently, replace the serial converter unit.
			A servopack fault occurred.	Replace the servopack.
A.840	Encoder data error (Detected on the serial converter unit side)	Occurred when the control power supply was turned ON.	A malfunction occurred in the serial converter unit.	Turn the control power supply OFF and then ON again. If this alarm occurs frequently, replace the serial converter unit.
			A servopack board fault occurred.	Replace the servopack.
		Occurred during operation.	A malfunction occurred in the serial converter unit.	Correct the wiring around the serial converter unit by separating the serial converter unit cable from the power line, or by checking the grounding and other wiring.
			A serial converter unit fault occurred.	If this alarm occurs frequently, replace the serial converter unit.
			A servopack board fault occurred.	Replace the servopack.



Alarm Display	Alarm Name	Situation at Alarm occurrence	Cause	Corrective Actions
A.C10	Servo overrun detected	Occurred when the control power supply was turned ON.	A servopack board fault occurred.	Replace the servopack.
		Occurred when the servo was on or a reference was input.	The order of phase-U, -V, and -W in the servomotor wiring is incorrect.	Correct the servomotor wiring.
			The polarity detection is not performed properly (When Pn080.0=1 is set)	Correct the setting for the polarity detection related parameter.
			A serial converter unit fault occurred.	Replace the serial converter unit.
			A servopack fault occurred.	Replace the servopack.
A.C20	Phase detection error	Occurred while motor was running.	The linear scale signal level is too low.	Mount the scale head exactly, or replace the linear scale.
			The linear scale count-up direction does not agree with the forward moving direction of linear motor moving coil.	Change the setting of Pn080.1(motor phase order selection). Install correctly linear scale and linear motor moving coil.
			Noise interferes with the hall sensor signal.	Correct the FG wiring and take measure to avoid noise.

Alarm Display	Alarm Name	Situation at Alarm occurrence	Cause	Corrective Actions
A.C90	Encoder communication error	Occurred when the control power supply was turned ON or during operation.	The serial converter unit wiring and the contact are incorrect.	Correct the serial converter unit wiring.
			Noise interference occurred due to incorrect serial converter unit cable specifications.	Use tinned annealed copper twisted-pair or twisted-pair shielded wire with a core of at least 0.12mm <sup>2</sup> .
			Noise interference occurred because the wiring distance for serial converter unit cable is too long.	The wiring distance must be 20m max.
A.C91	Encoder communication position data error	Occurred when the control power supply was turned ON or during operation.	The noise interference occurred on the signal line because the serial converter unit cable is bent or the sheath is damaged.	Correct the serial converter unit cable layout.
			The serial converter unit cable is bundled with a high-current line or near a high-current line.	Correct the serial converter unit cable layout so that no surge is applied.
			The FG potential varies because the influence from machines on the servomotor side such as the welder.	Make the grounding for the machine separately from PG side FG.
A.C92	Encoder communications timer error	Occurred when the control power supply was turned ON or during operation.	Noise interference occurred on the signal line from the serial converter unit.	Take measure against noise for the serial converter unit wiring.
			Excessive vibration and shocks were applied to the serial converter unit.	Reduce the machine vibration or mount the servomotor securely.
			A serial converter unit fault occurred.	Replace the serial converter unit.
			A servopack board fault occurred.	Replace the servopack.

**\* Troubleshooting for malfunction without Alarm Display.**  
**(Turn OFF the servo system before executing operations.)**

Symptom	Cause	Inspection	Corrective Actions
Linear servomotor does not start when using JOG operation and host reference.	The control power supply is not ON.	Check voltage between control power supply terminals.	Correct the control power circuit.
	The main circuit power supply is not ON.	Check voltage between power supply terminals.	Correct the power circuit.
	Wrong wiring or disconnection of I/O signal connector CN1	Check if the connector CN1 is properly inserted or connected.	Correct the connector CN1 connection.
	Linear servomotor or serial converter unit wiring disconnected.	Check the wiring.	Connect the wiring.
	Overloaded	Run under no load.	Reduce load or replace with larger capacity servomotor.
	Speed/position reference not input	Check reference input pin.	Input speed/position reference correctly.
	Servo-ON(/S-ON) input signal stays OFF.	Check settings of parameters Pn50A.0 and Pn50A.1.	Correct the parameter setting and turn ON /S-ON input signal.
	Control method selection is incorrect.	Check parameter Pn000.0.	Set parameter to match the application.
	Reference pulse mode selection is incorrect.	Check the parameter setting for the reference pulse mode(Pn.200.0).	Correct setting of parameter Pn.200.0.
	The forward run prohibited(P-OT) or reverse run prohibited(N-OT) input signal is turned OFF.	Check P-OT, N-OT input signal.	Turn P-OT or N-OT input signal ON.
	A servopack fault occurred.	A servopack board fault occurred.	Replace the servopack.

Symptom	Cause	Inspection	Corrective Actions
Linear servomotor moves instantly, and then stops.	Servomotor wiring is incorrect.	Check the servomotor wiring.	Correct the servomotor wiring.
	Serial converter unit wiring is incorrect.	Check the serial converter unit wiring.	Correct the serial converter unit wiring.
	Linear scale wiring is incorrect.	Check the linear scale wiring.	Correct the linear scale wiring.
	Linear scale pitch(Pn282) is incorrect.	Check the setting of Pn282.	Correct the setting of Pn282.
	Linear scale counting up direction and linear servomotor moving coil forward direction are not agreed.	Check the direction.	Change the setting of Pn080.1(motor phase order selection). Match the linear scale direction and moving coil direction.
Linear servomotor speed unstable	Wiring connection to servomotor is defective.	Check connection of power lead(phases U, V, and W) and encoder connectors.	Tighten any loose terminals or connectors.